AN UNUSUAL CASE OF RECURRENT HYPOKALEMIA FOLLOWED ELECTRORETINOGRAPHICALLY

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The effect of different ions on the electroretinogram (ERG) was studied by BEUCHLT in 1921, but his method was rather slow to give satisfactory informations as to the selective effect on the retinal potentials. Later THERMAN (1938) found that application of 0.5% potassium chloride in isotonic glucose to the opened eye of the frog quickly removed the positive responses, leaving an isolated negative ERG. To quote from GRANIT (1947) the very first effect of potassium was that of removing the small oscillations superimposed on the ERG; the next effect was to increase the $a$–wave and diminish the $b$–wave.

More recently HAMASAKI (1963, 1964) investigated the effect of various ions on the isolated retina of the frog and concluded that both the $a$ – and $b$ waves originate from the photoreceptors. FURUKAWA & HANAWA (1955) using the retina of the toad treated with aspartate, showed that the $a$-wave increases with increasing external sodium concentration. The same was found by SILLMAN, ITO & TOMITA (1969). These experiments demonstrated that, except at very low concentrations, the amplitude of the receptor potential (PIII) increased in direct proportion to the logarithm of the external sodium concentration. With regard to potassium the relationship was inversely linear (external potassium concentration on a log scale).

We were fortunate in having the opportunity to observe an unusual case of recurrent hypokalemia, a rare disease in which, as it will be discussed below, there is an increase of intracellular potassium.

CASE REPORT

The patient A.M., male aged 45, suffered since 5 years from periodic palsies, lasting on average from 12 to 48 hours. The episodes were characterized by intense weakness or complete paralysis of limb and trunk muscles. During the attack the tendon reflexes were absent or greatly reduced, but returned to normal as strength and tone returned. As in the typical form the attacks were precipitated by such factors as physical stress or a large high – carbohydrate meal.

Normal serum potassium of the subject, as measured with flame photometry, was 4.3 meq/l: during the episodes levels as low as 3.1 meq/l were reached. The
$b$-wave increased during the attacks, the values ranging from 250 $\mu$V ($K^+ = 4.3$) to 410 $\mu$V ($3.1$) (see fig. 1).

The $a$-wave was unchanged.

It is interesting to report in this connection that the electrocardiogram was typical of high potassium level in the heart muscle, the main features of that being an increase of the P-Q latency and a deepening of the S-T.

<table>
<thead>
<tr>
<th>ERG (b-wave) $\mu$V</th>
<th>$K^+$ meq/l</th>
<th>$Na^+$ meq/l</th>
<th>$Cl^-$ meq/l</th>
<th>ECG</th>
</tr>
</thead>
<tbody>
<tr>
<td>µV 250</td>
<td>4.3</td>
<td>144</td>
<td>101</td>
<td></td>
</tr>
<tr>
<td>µV 294</td>
<td>3.9</td>
<td>143</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>µV 330</td>
<td>3.5</td>
<td>144</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>µV 378</td>
<td>3.3</td>
<td>144</td>
<td>101</td>
<td></td>
</tr>
</tbody>
</table>

**DISCUSSION**

We have reported a rare case of muscle paralysis caused by a decrease in blood potassium (hypokalemia) due to an increase of the ion in the muscle cell.

As we have seen, the $b$-wave was increased whereas the $a$-wave remained unaffected. This poses the following questions:

1. why the $b$-wave is increased
2. why the $a$-wave is unchanged
3. do the results agree with previous experiments on the effect of electrolytes changes on the ERG.

We suggest the following explanations:

Question 1. The $b$-wave increases because of an elevation of the resting potential produced by an increase of the intracellular potassium and a corresponding reduction of that of the external medium.

This results is an increase of the electrochemical gradient.